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Design and Analysis of Four Port Antenna Using MIMO Technique for Wi-Fi Applications

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Abstract: *The design and analysis of four port antenna is carried out in this work using latest multiple input multiple output techniques for 2.4 GHz Wi-Fi applications. The antenna is designed using low profile microstrip patch antenna (MPA). The MPA is the antenna which can place in any metallic surface. In the initial work of the thesis single antenna is designed and optimized using CST-Microwave Suit software, then it converted in four element antenna and optimized. The proposed antenna is considered and designed for Wi-Fi applications. The various results are calculated like gain, efficiency, envelop correlation coefficient, far field parameters etc. The proposed four port antenna is resonates at 2.4 GHz with return loss coefficient (S11) is -14 dB and isolation coefficient (S12, S13, S14, S21, S31, S41, S23, S24, S42, S32 etc.) is below -20 dB. The voltage standing wave ration is maintained to 1.4 at resonant frequency. The gain of the antenna is 3.13 db at resonant frequency while the directivity is 5.9 dB at resonant. The radiation efficiency of proposed antenna is more than 50 %. The band of the antenna is varies from 2.35 to 2.40 GHz. The approximate bandwidth of the four ports multiple inputs multiple output antenna is 47 MHz. All other antenna parameters are evaluated and discussed.*

1. *Material, Methodology and Design:*

Microstrip Patch Antenna Design consists of a rectangular patch with inset feed line power supply. Rectangular patch structure is simple and easy to design. Here the modified hexagon structure used to design the antenna and it resonates at 2.4 GHz. Antennas are placed on dielectric layer and common ground plane made up of copper.

The Figure 1 shows the design of microstrip patch antenna. In this figure there are four patches having overall substrate width of single element is W = 50 mm and length L= 50 mm. The patches are mounted on a single substrate. The back view of proposed antenna is given in figure 2. The length of antenna is equal to the substrate length while width is less as compare to substrate.

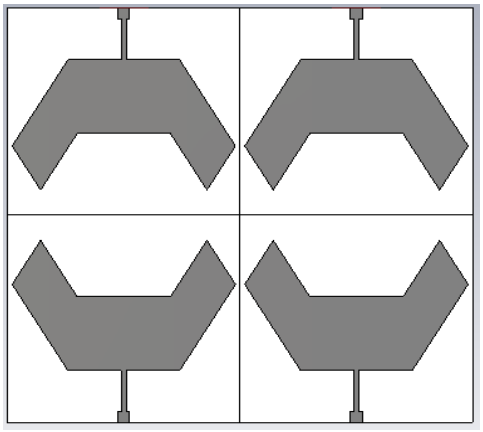

Figure 1: Front View of Proposed antenna

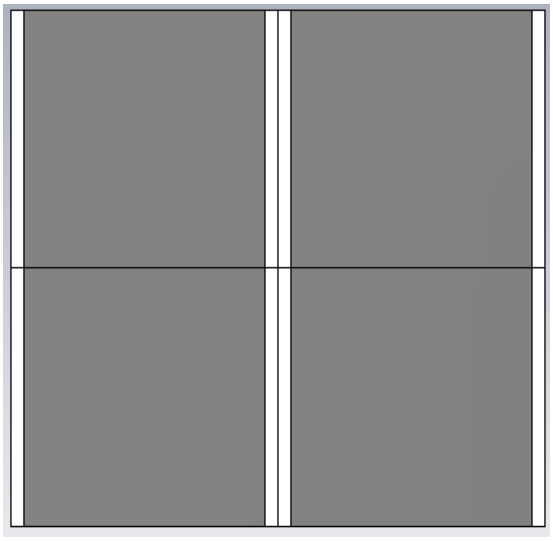

Figure 2: Back View of Proposed antenna

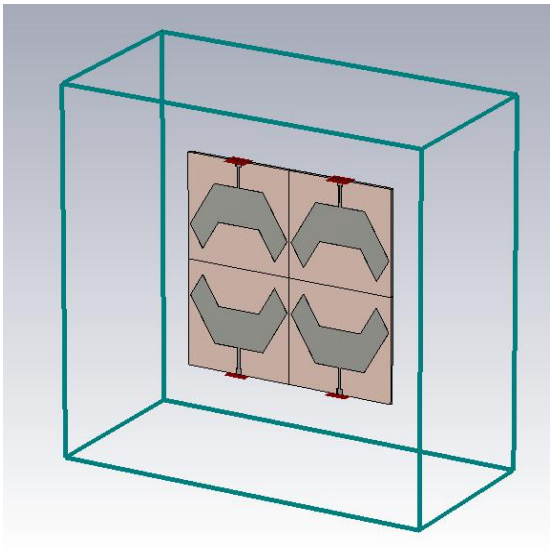

Figure 3: Prospective View of Proposed antenna

Table 1: Dimension of antenna

Name	Expression	Value	Description
sw	= 50	50	Substrate Width
sl	= 50	50	Substrate Length
sh	= 1.524	1.524	Substrate Hight
r	= 24.000816166112	24.000816166112	Cut Radius
gw	= 45	45	Ground width
gl	= 50	50	Ground Length
gh	= .07	.07	Ground Height
fw1	= 1.0475346012994	1.0475346012994	Feed Width 1
fw	= 2.4752595669756	2.4752595669756	Feed width
fl1	= 9.9	9.9	Feed Length 1
fl	= 2.7	2.7	Feed Length

2. Result and Discussion:

S- Parameter Calculation:-The simulation results of above microstrip patch antenna structure at a frequency of 2.4 GHz is shown in graphs below. The antenna is resonates at 2.4 GHz with return loss coefficient is below -15 dB an isolation coefficient is below -20 dB.

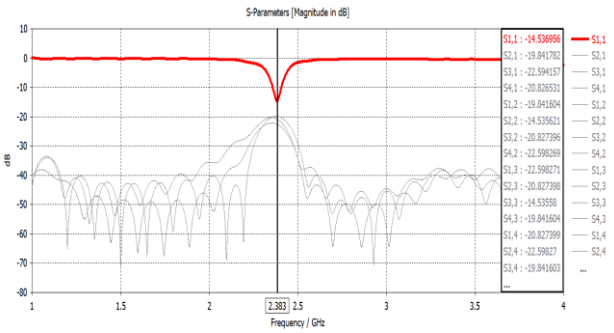

Figure 4: S-parameters results

The proposed antenna is ranges from 2.3576 GHz to 2.4055 GHz and overall bandwidth ps 47 MHz. The bandwidth plot of antenna is given in figure 5.

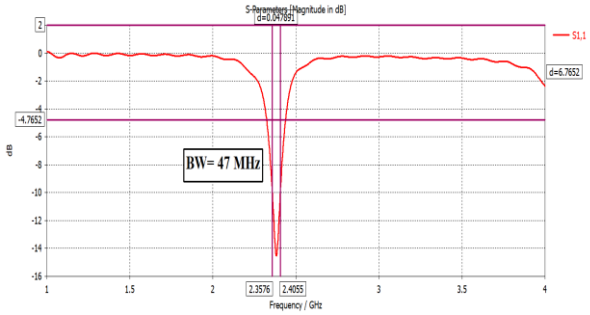

Figure 5: Bandwidth antenna

In figure 6 main lobe magnitude is 4.6 dBi and main lobe direction is 10 degree.

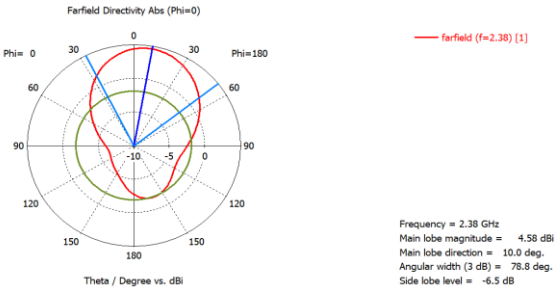

Figure 6: Radiation Pattern

The gain of antenna element is discussed in figure 7. The antenna element are identical thus the gain is uniform and it is 3.12 dBi at resonance frequency.

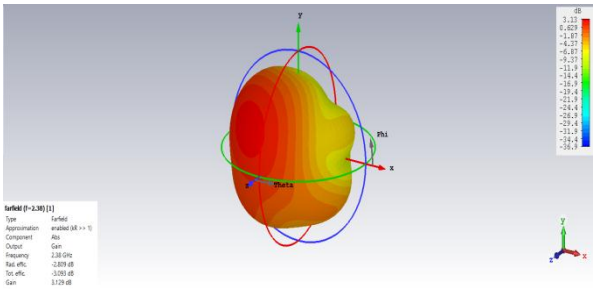

Figure 7: Gain of antenna

Graph shows that The VSWR parameter for the micro strip patch antenna is 1.46 for 2.4 GHz at port 1, 2, 3 and 4.

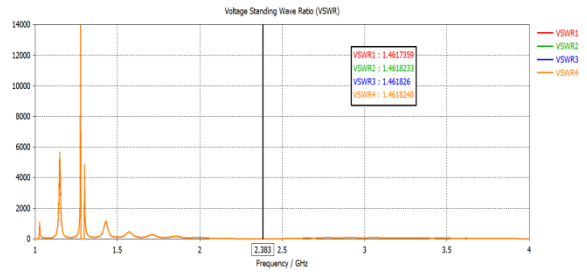

Figure 8: VSWR of antenna **Conclusion**: A four port modified hexagon antenna design is introduced using the appropriate design formulas and is simulated using the CST Studio Suite software. The antenna is designed at frequencies 2.4 GHz. From the results one can observe that this structure blocks the large amount of surface current entering to nearby patch antenna. the antenna has return loss coefficient (S11) is -14 dB and isolation coefficient (S12, S13, S14, S21, S31, S41, S23, S24, S42, S32 etc.) is below -20 dB. The VSWR is 1.4 at 2.4 GHz. The directivity and gain of the antenna is 5.9 dBi and 3.13 dBi respectively. The radiation efficiency of proposed antenna is more than 50 %.

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